

## Marine VHF Antennas (aerials) and their installation

From

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VHF radio range is line of sight, so height is a very important factor in achieving maximum range. On a yacht the most suitable antenna location is, therefore, at the top of the mast. Two boats, each with a masthead antenna 60' above sea level can theoretically communicate at about 20 miles. A transmitter at a coast station, perhaps 1000 feet above sea level, could communicate with these same boats at closer to 50 miles.

For those who wish to do the maths themselves the formula is:  $D1 + D2$  (total distance between stations in nm) is equal to  $1.23(\sqrt{H1} + \sqrt{H2})$ , where H is height of the antennas in feet.

Accepting that the VHF antenna must be positioned as high as possible on the boat we can turn to other factors that will affect radio performance:

It is a simple fact that the potential performance of a marine VHF radio is limited by the quality of the antenna and its installation. A badly designed antenna fitted with undersized cable and imperfect connections will make the performance of even the most exquisite and expensive radio unacceptable.

It is important to select the right antenna and install it in such a way that it maximises the performance of the radio to which it is attached.

### Selecting an antenna

Antenna performance, or *gain*, is expressed in decibels – dB. A 9dB antenna increases the signal power eightfold, a 6dB antenna fourfold and a 3dB antenna, the best selection for masthead applications, doubles signal power.

But why choose a 3dB antenna for the masthead when you could get all that extra power from a 9dB antenna?

Well, the increased signal strength of a high gain antenna is achieved by concentrating the signal radiating from it into a narrow disc. The signal radiates at right angles to the antenna with very little radiation upwards or downwards. When the boat heels and the antenna rocks backwards and forwards the concentrated disc-like radiation pattern points the signal at the sky, or at the sea, instead of at the horizon. A 3dB gain antenna has a radiation pattern that looks more like a fat doughnut than a disc, with a significant portion of the signal radiating upwards and downwards. No matter how much the boat heels, such an antenna will still have some portion of its signal looking at the horizon and, because VHF transmissions are line-of-sight, this is vital to performance. Hence the universally accepted use of a 3dB gain antenna for boating applications, particularly for masthead mounting.

Another measure of antenna performance is the SWR – Standing Wave Ratio. (You may see this referred to as VSWR, Voltage Standing Wave Ratio, but it is the same thing). This is, in very simple terms, a measure of the amount of the transmission power that is lost in the antenna system. If the antenna system were perfect and the

entire signal power leaving the radio was transmitted by the antenna (and its cables and connections) the SWR would be 1:1. Sadly this is not achievable, but getting as close as possible is a worthy aim. A SWR of 2.0:1 over the whole system represents a ½ dB loss in signal strength and is barely acceptable. To achieve or, preferably, better this performance the antenna itself should have the best possible SWR. A top quality antenna such as the Metz Manta-6 has a SWR of less than 1.2:1. Others will have a SWR of 1.5:1 or higher.

Other criteria for selecting a marine antenna, particularly one for masthead mounting, would be:

- Resistance to UV degradation. Clearly all stainless steel construction wins hands down.
- Resistance to bird strikes. Again, a stainless steel whip is less vulnerable than a rigid plastic one.
- Ability to be removed when the mast is taken down. This is when the antenna is particularly vulnerable and those with factory crimped connections cannot be removed without removing all the cable with them. The connection at the antenna should be an SO239 socket which takes the standard PL259 connector.
- Low weight.
- Sturdy mounting bracket.

The Metz antenna satisfies all these criteria. Its excellent durability as a result of stainless steel construction makes it the choice of the US Coastguard for their Search & Rescue fleet.



*Metz VHF antenna*

Once the antenna has been selected we can turn to the other components of the antenna system; the cable and connectors.

#### Cable:

Marine VHF applications require 50 ohm coax. TV cable is 75 ohm and is not suitable.

Suitable cables include RG-58 (smallest), RG-8X, RG-8U and RG213. RG-213 is the same size as RG-8U but with completely waterproof and ultra-violet resistant insulation. RG-213 is more difficult to work with when it comes to making connections and is very expensive, so probably best left to superyachts. RG58 is only suitable for interconnections between equipment and for very short runs.

RG-8X is recommended for runs up to about 15 or 20 meters and RG-8U for longer runs. (This is also the recommendation of the IOC and ISAF as the best means of achieving their Cat 1 offshore race requirement for an antenna feeder cable with less than 40% loss)

Coax must have copper braid, preferably tinned copper braid. Braid is described by percentage figures – 98% is the best, 96% is good. It is important that the dielectric, the insulating surrounding the centre core of the cable, is solid polyethylene. Foam core dielectrics can suck moisture into the cable via the connections and cause the core and braid to corrode.

A good UV resistant cover is essential for longevity.

Ancor Marine Products produces a top quality RG8X cable specifically for marine applications at a very competitive price.

#### Connections:

One of the biggest causes of failure in an antenna system is faulty connections. These allow water into the coaxial cable causing corrosion of the braid and centre conductor. So, high quality connectors are required.

The cable terminal is the PL-259 plug. This plug fits RG8U cable and, with suitable adaptors, RG8X and RG58. The PL259 connector mates with an SO-239 socket as fitted to the Metz Manta-6 and other top quality antennas.



*SO 239 socket at the base of a Metz antenna*



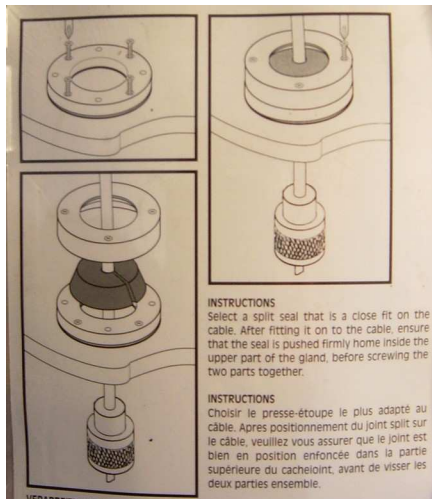
*PL259 connector*

Two PL-259's can be connected together using a barrel connector, PL-258.

Connections should be soldered. Many manufacturers use pressure crimped connections but these are subject to corrosion and need special tools to create the connection. Remember, you should be able to remove the antenna when the mast is taken down for winter storage.

#### Cable run:

An ideal installation would have the cable make an uninterrupted run from the antenna connector to the radio socket but this is hardly practical. A good compromise is to make the connection inside the boat, out of the harsh marine environment. A cable gland through which the entire PL259 plug will pass is available so that an interior connection can be made without the need to remove the plug when removing the mast. The masthead connection and any other exterior connections should be protected with self-amalgamating tape.



*A cable deck gland that allows the cable with PL259 connector attached to pass through it.*

The coaxial cable can be run inside or outside the mast. If the run is on the outside it is particularly important to have a UV resistant cover; a white exterior jacket looks less industrial on most masts than the more common black or brown cable.

If the cable is inside the mast it should be restrained to prevent tangling with halyards or other cables, and to avoid the maddening rapping of the cable against the mast. Modern mast sections have in-built channels through which the cable can be run. Older masts should, if at all possible, have a conduit fixed inside. As a last resort the cable can be fitted with groups of three plastic cable ties at about ten foot intervals, with the tails of the cable ties radiating out to the interior wall of the mast. This will hold the cable off the mast wall somewhat, but will not avoid abrasion from halyards or other cables. On wooden masts it is usual for the cable to be run externally.

A top quality antenna such as the Metz, combined with the correct cable and well made connections, will release the full potential of your VHF radio.